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– *Uranium in the Seventies* –

A CANADIAN PRODUCER'S VIEWPOINT

by John Kostuik
President
DENISON MINES LIMITED

Presented to

THE URANIUM CONGRESS

NOVEMBER 21, 1969 BERLIN

4 King Street West,
Toronto 1, Ontario

ANNUAL AND GENERAL MEETING OF SHAREHOLDERS

NOTICE IS HEREBY GIVEN that the annual and a general meeting of the shareholders of DENISON MINES LIMITED (hereinafter called the "Company") will be held in the Crystal Ballroom, King Edward Sheraton Hotel, 37 King Street East, Toronto, Ontario, on Thursday, the 30th day of January, 1969 at the hour of 11:00 o'clock in the forenoon (Toronto time) for the following purposes:

1. To receive the consolidated balance sheet of the Company and its subsidiaries as at December 31, 1968 and the consolidated statements of income and retained earnings and of source and application of funds for the year ended December 31, 1968 together with the reports of the directors and auditors thereon;
2. To appoint auditors;
3. To elect directors;
4. To consider and, if approved, confirm an agreement made as of the 15th day of March, 1968 between the Company, Roman Corporation Limited, Goldray Mines Limited, Waldimer Paul Boyko, Atlantic Richfield Company and International Mining Corporation providing, on the terms and conditions set out therein, for a major exploration programme in northern Saskatchewan and Manitoba;
5. To ratify the omission of information as to sales or gross operating revenue (except such information as is contained in notes to the statements referred to in this paragraph 5) from the comparative interim financial statement (on a consolidated basis) of the Company for the six-month period ended June 30, 1968 and for the corresponding six-month period in the immediately preceding twelve months (which comparative interim financial statement was set forth in the Company's interim report dated July 31, 1968) and from the comparative statement of income (on a consolidated basis) of the Company for the year ended December 31, 1968 and for the immediately preceding financial year (which comparative statement is set forth in the Company's annual report for 1968); and
6. To transact such further and other business as may properly come before the meeting or any adjournment or adjournments thereof.

NOTICE IS HEREBY FURTHER GIVEN that each of the following directors of the Company has an interest in the agreement referred to in paragraph 4 hereof in that: The Hon. George A. Drew is a shareholder of Roman Corporation Limited; Mr. John Kostuik is a director and shareholder of Roman Corporation Limited; Mr. Edward A. Merkle is a director of International Mining Corporation; Mr. J. G. Pickard is a shareholder of Roman Corporation Limited; Mr. John C. Puhky is an officer and shareholder of Roman Corporation Limited and a shareholder of Goldray Mines Limited; Mr. Anthony Roman is a shareholder of Roman Corporation Limited; Mr. Stephen B. Roman is a director, officer and shareholder of Roman Corporation Limited and a director of International Mining Corporation; and Mr. B. E. Willoughby is a director and shareholder of Goldray Mines Limited and a shareholder of Roman Corporation Limited.

Shareholders who are unable to be personally present at the meeting are requested to date, sign and return in the envelope provided for that purpose the enclosed form of instrument of proxy for use at the meeting.

DATED at Toronto this 15th day of January, 1969.

By Order of the Board,

JOHN C. PUHKY,
Secretary.

DENISON MINES LIMITED

4 King Street West,
Toronto 1, Ontario

INSTRUMENT OF PROXY Nº 11527

The undersigned shareholder of DENISON MINES LIMITED hereb appoints Stephen B. Roman, of Toronto, Ontario, or failing him, Joh Kostuik, of Toronto, Ontario, or failing him, E. B. McConkey of Toront Ontario, or instead of any of the foregoing .....
of ..... as the nominee of the undersigne to attend and act for the undersigned and on behalf of the undersigne at the annual and a general meeting of the shareholders of Denison Mine Limited to be held on the 30th day of January, 1969 and at any adjourn ment or adjournments thereof in the same manner, to the same extent an with the same power as if the undersigned were present at the said meetin or such adjournment or adjournments thereof, and, without limiting th general authorization and power hereby given, the persons named abov are specifically directed to vote as indicated below:

FOR ☐ AGAINST ☐ Resolution confirming the agreement re ferred to in paragraph 4 of the notice of the said meeting.

FOR ☐ AGAINST ☐ Resolution ratifying the omission of in formation as to sales or gross operating revenue from certain financia statements as referred to in paragraph 5 of the notice of the said meeting.

(continued, and to be dated and signed, on other side)

Globe and Mail,
140 King St. W.,
Toronto 1, Ont.

This proxy will be voted as directed. Unless otherwise indicated above this proxy will be voted for the resolution confirming the agreement referred to in paragraph 4 of the notice of the said meeting and in the information circular for such meeting, receipt of which is hereby acknowledged, and for the resolution ratifying the omission of information as to sales or gross operating revenue from certain financial statements as referred to in paragraph 5 of the notice of the said meeting and in the said information circular. If any amendments or variations to matters identified in the notice of meeting are proposed at the meeting or if any other matters properly come before the meeting, this proxy confers discretionary authority with respect thereto on the nominee hereby appointed.

DATED this . . . . day of January, 1969.

. . . . . .
Signature of Shareholder

NOTE: 1. This form of proxy **must be dated** and executed by the appointor or his attorney authorized in writing or, if the appointor is a corporation, under its corporate seal or by an officer or attorney thereof duly authorized.

2. **This proxy is solicited by or on behalf of the management of the Company.**

UNITED STATES
ATOMIC ENERGY COMMISSION
WASHINGTON, D.C. 20545

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FOR RELEASE AT 2:00 PM PST
(5:00 PM EST)
MONDAY, DECEMBER 1, 1969

Remarks by
Wilfrid E. Johnson, Commissioner
U. S. Atomic Energy Commission
at the
1969 Annual Conference of the
Atomic Industrial Forum
San Francisco, California
December 1, 1969

AEC URANIUM POLICIES

Mr. Chairman, fellow participants in this session on uranium, ladies and gentlemen, I am glad to have this opportunity to take part in the Atomic Industrial Forum's annual conference. The scheduling of the session on uranium early in this conference is appropriate. It underscores the basic importance to the nuclear industry of the continued availability of uranium at acceptable costs. Others on this program will deal with the economics of exploration for and exploitation of uranium deposits. My own assignment is to outline my thinking as one AEC Commissioner on proposed programs and policies which may bear directly on the adequacy of future uranium supply.

There has been much discussion and even more speculation on the timing of the removal, either wholly or partially, of the existing restriction on the enrichment in Government-owned plants of foreign uranium for domestic uses. Similarly much has been said and written on possible approaches to the disposal of excess Government uranium stocks.

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Prospective Government actions in these areas are, of course, important to all segments of the nuclear industry, not only to the uranium producers and the ultimate consumers, but to suppliers of nuclear plants and components as well. Unwise or ill-timed actions could tend to restrict needed exploration or investment in production facilities on the required time schedule, could create future uranium supply problems and could possibly limit the rate of growth of nuclear power. Therefore, we believe that policies relating to foreign imports and disposal of excess stocks must be developed with care. We are endeavoring to obtain all the facts we can, and to seek the advice of those affected by proposed actions.

As you know the Commission has been considering both matters for some time. I had hoped that consideration of these problems would have reached the point where I could discuss them today in detail. But as things now stand I will confine my remarks to an outline of my own current thinking, reminding you that until we are ready to submit proposed plans for comment, my remarks must not be regarded as proposals.

Two thoughts should be borne in mind. First, the legislative history surrounding the present restriction on foreign uranium clearly calls for its removal as soon as this can be done while still maintaining a viable domestic uranium industry. There is no simple answer to the question of how or when, but there is an obligation to make a beginning as soon as conditions permit. Second, it seems unrealistic to expect that Government stocks in excess of foreseeable needs would be held indefinitely. Their immense value precludes this solution to the problem but it also dictates that they be handled prudently, keeping in mind the needs of the industry as well as the interests of the taxpayers. In any event, it appears that the disposal schedule may have to extend over a number of years.

Recent projections and extrapolations indicate that the long-term outlook for the uranium producing industry remains good but we all recognize that the limited market situation may extend into the middle 1970's. On the supply side, recent exploration activities in the United States are having good results and leave little basis to be pessimistic about long-range uranium availability. Drilling will reach an all-time high this year, on the order of

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30 million feet. But there are signs that exploration activity may soon decline somewhat as the producers assess the near-term supply-demand situation.

As a result of slippage in reactor construction schedules and other factors, the uranium purchase commitments of some utilities and reactor manufacturers are in excess of current needs, resulting in excess inventories which may not be worked down to normal levels for several years. Current and projected short-term productive capability, both within the U. S. and abroad, is substantially in excess of commercial requirements, and it appears that it may remain so at least through 1975. Of course, there are also the excess stocks of uranium held by the U. S. and Canadian Governments. Much of the U. S. Government surplus was accumulated during the recent period of declining national defense needs. Its purchase during a period of minor commercial demand helped sustain the producing industry. It is against this backdrop that we are viewing the problems posed by the present restrictions on the enrichment of foreign uranium and the existence of large surplus stocks of uranium in AEC inventory.

The Restriction on Enrichment of Foreign Uranium

Under Section 161 v. of the Atomic Energy Act, the Commission, to the extent necessary to assure the maintenance of a viable domestic uranium industry, may not offer enrichment services for source or special nuclear materials of foreign origin intended for use in domestic reactors. At the present time, the Commission is offering enrichment services for foreign uranium only if the enriched product is to be re-exported.

The purpose of the restriction was to assist the domestic uranium producing industry to weather a period of low requirements. It was plainly not intended to provide protection against foreign competition indefinitely. The Act and its legislative history provide only that the restriction on enrichment should remain in force for a limited period in order to preserve in being an industry which is capable of responding and expanding to meet the needs of the future. The Commission has announced in the past that it intends to keep this restriction in effect only so long as necessary, and that it will announce plans for its removal as far in advance as possible. This policy

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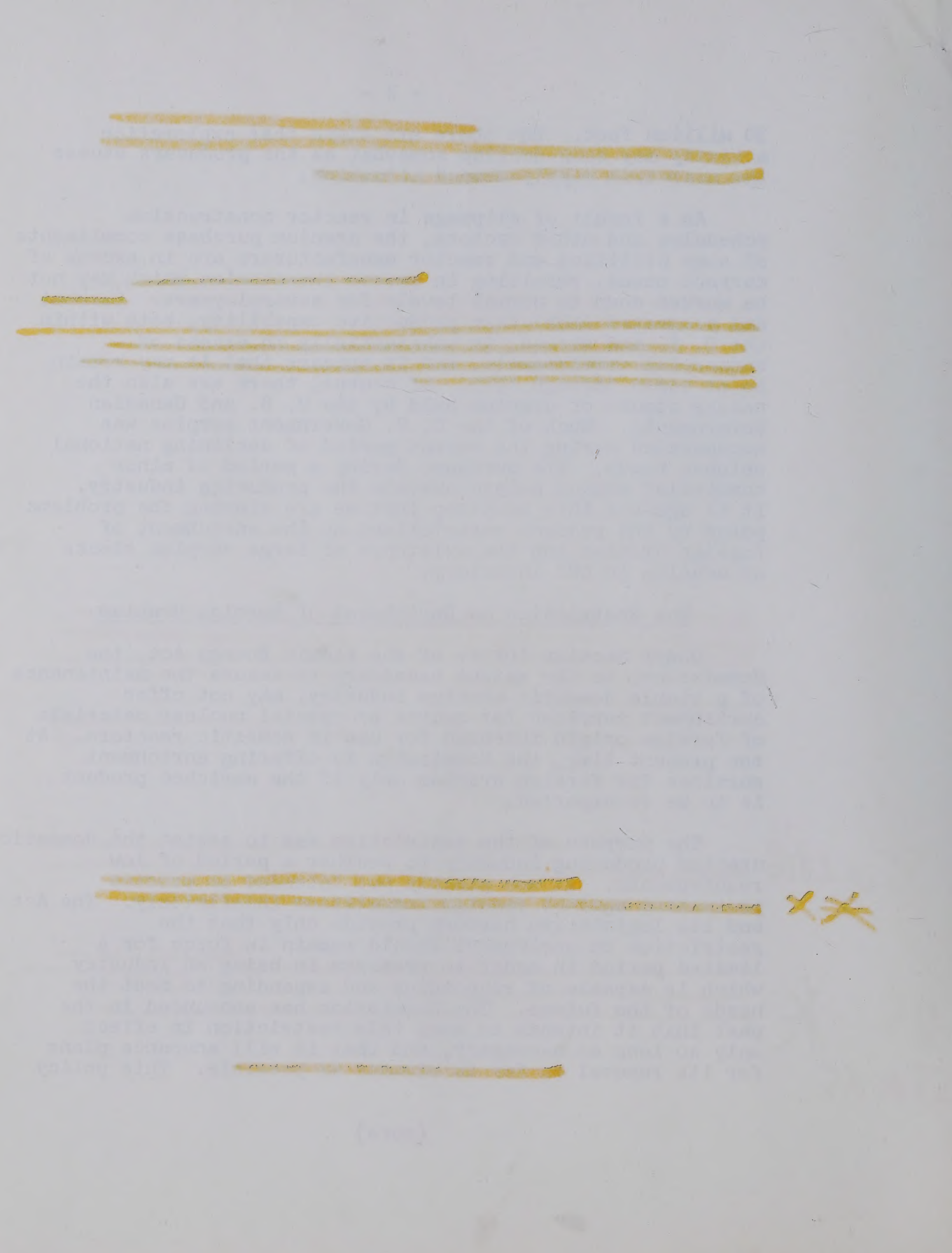

has not been changed. Removal or relaxation of the restriction would constitute a revision of the Uranium Enrichment Services Criteria. Commission decisions on this matter must be submitted to Congress for a period of 45 days prior to formal establishment.

The questions remain - how and when? Domestic sales commitments for 1970 are about 13,000 tons of U_3O_8. However, after completion of AEC purchases in 1970, there will be a substantial drop in sales for domestic producers. The production capacity of the industry will be well above sales commitments. Since the requirements for commercial uranium for the early 1970's have largely been filled, this condition will continue for a few years. During the same period foreign production capacity will be well above foreign requirements.

Thus, if the restriction were to be removed entirely within the next few years, the amount of foreign uranium that could be offered in the U. S. market, concurrently with a situation of domestic overcapacity, could have a severe adverse effect on the domestic uranium producing industry. As a consequence, funds for the conduct of further exploration programs might be curtailed.

The advantages of a gradual removal of the restriction are persuasive. The extent of the impact of the action on the viability of the domestic industry would be more closely controlled. Further, the commencement of removal of the restriction could occur perhaps several years earlier than if the restriction were removed in a single step.

Various methods have been studied for allocating the quantity of foreign uranium that would be accepted for enrichment by AEC under the approach of a graduated schedule for relaxation and removal of restrictions. The simplest procedure that we might employ would be to establish a percentage quota, applicable to those furnishing uranium for enrichment. Under such an approach, each company requiring enrichment services could, if it wished, furnish as feed for a specific order under an enriching services contract up to a stated maximum permissible proportion of uranium of foreign origin.

In view of the large forward delivery commitments that have already been made by some domestic producers,

there are some consumers who do not need to make further uranium purchase arrangements for some years to come. They might not be interested in purchases of foreign uranium in the near term unless prices were low.

Other consumers, however, have not yet made uranium purchase commitments to cover their requirements and might be interested in using foreign materials to the extent permitted. In view of the probability that there will be a limited remaining market over the next five years or so, the long-term domestic purchase arrangements already made, and the accumulating surplus of some consumers, there is the possibility that under a simple quota system foreign uranium might absorb the remaining domestic market.

To assure that a part of future sales would be made by domestic producers, the plan might need to contain a provision that the foreign uranium feed supplied for enrichment for domestic use must be accompanied by a specified proportion of domestic uranium procured and delivered under new purchase agreements made after a specified date and which represent additional procurement commitments. It would be the intent that such additional purchases would be from domestic primary producers, would be derived from domestic mines, and would represent an additional market for the domestic uranium producing industry. Under this approach, reactor manufacturers and utilities holding excess inventories of domestic uranium could, of course, continue to have such material enriched, but they would have to make new domestic purchases to the extent specified if they wished to use foreign uranium.

This type of provision would serve two objectives. It would reserve a proportion of the additional market, whatever its size, for the domestic producer. It also would permit the AEC to specify a larger percentage of uranium of foreign origin at the outset than would otherwise be possible. Thus, the consumer in need of uranium would be able to make firm long-term contracts for future delivery of significant quantities from both domestic and foreign producers. As the need for new purchase arrangements increases, the total tonnage which may be obtained from foreign sources would increase also.

As an initial step in the lifting of the restriction, I favor a proposal to permit any individual to furnish,

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beginning in 1973, specified amounts of foreign uranium provided that it is accompanied by specified amounts of domestic feed derived from new purchases additional to present purchase commitments. The initial amounts of foreign feed permitted would be established conservatively in order to avoid possible serious injury to the domestic industry. However, once the initial proportion of foreign uranium is established it would not be reduced thereafter, and any consumer could make long-term contracts for foreign uranium to cover that part of his requirements. From time to time, perhaps annually, the Commission would review the need for continuing the residual restriction and, as conditions permit, increase the proportion of foreign uranium that would be accepted.

The Surplus Uranium Inventory

As the result of earlier cutbacks in the production of fissionable materials for national defense, the AEC will have a substantial surplus, currently projected for planning purposes as equivalent to 50,000 tons of U_3O_8. The material will be in various forms, largely uranium concentrates and/or UF_6. The quantity is subject to many uncertainties which stem from the difficulty of estimating long-range Government requirements.

Plans for disposal of this surplus must take into account the remaining market for domestic production and the effect on such market of the relaxation or removal of the restriction on foreign uranium. It is anticipated that, once AEC disposals begin, the quantities offered for sale would be based on a sharing of further market growth. Because of the large quantity involved and its potential market impact, the disposal of AEC uranium will necessarily extend over a period of years. Sales would be at gradually increasing rates in the first few years and taper off toward the end of the disposal program.

In order to provide assurance to the uranium mining industry that Government sales will not be overly burdensome, I have been considering two limiting conditions on annual sales. One would limit the total amount offered for delivery in any year to a fixed proportion of the total projected domestic requirement for that year. The other would provide that the increase in the amount to be offered for delivery from one year to the next would not exceed a fixed proportion of the projected market increase

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In view of the normal industry procurement lead times in contracting for uranium, it will be necessary to establish offering dates several years earlier than the delivery dates for the material.

We have been in the business of estimating forward uranium requirements for some years now, long enough to realize the difficulties, uncertainties, and inevitable imprecision of predicting the future, even in such a limited area. We know that flexibility is essential if any long-range plan is to be administered effectively. Therefore, the AEC should retain the flexibility to revise its disposal plan as may be necessary should major changes occur in the domestic or foreign supply or requirements situation. Any proposals for substantial changes in these areas would be issued for public comment before adoption.

On the basis of the present market outlook, including the possible effect of relaxing the restriction on foreign uranium, I would expect that deliveries from our stockpile to the market would begin around 1975. The quantity offered might have to be quite small in the first year and possibly in the first few ensuing years so as not to affect adversely either the market or the market price. I would emphasize here the importance of not deferring indefinitely announcement of the time for beginning this program since to do so merely extends the period of uncertainty affecting not only the producers but also the customers. It is my firm conviction that before too much longer we should set a date for beginning the long-term program of disposal of our stockpile with the understanding that the quantities offered for delivery in any year, including the first one, would be carefully measured against the best estimates we can make of prospective market conditions.

What we are seeking is a long-range plan designed not only to permit disposal of Government stocks on a basis that will not be damaging to the industry, but also to provide the industry with a reasonable basis for its forward planning. In the alternative plans which I visualize, the amount to be offered for delivery in any year would not exceed a percentage, perhaps up to one-third, of the total projected domestic requirement for that year. Further, the increase in the amount offered for delivery from one year to the next would not exceed a reasonable percentage, possibly up to one-half, of the projected concurrent increase in annual

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domestic requirements. If our projections of annual requirements are reasonably close to the mark, it is the latter limitation that probably would be controlling in the early years.

It appears that the most practicable way of handling the initial sales would be on a bid basis. Producers as well as consumers, and foreign as well as domestic companies or individuals, could bid on the material. Material purchased for export would be subject to the same safeguards requirements as if it were obtained from any other source in the U. S.

We have received a few preliminary suggestions from the industry for alternative approaches to the disposal problem. We would expect to receive more after the industry has had an opportunity to analyze a specific AEC proposed plan.

I must emphasize that the plans I have outlined here today reflect only my current thinking. The Commission is willing to consider other alternatives which appear workable and reasonable. We sincerely invite all segments of the industry to examine the proposed plans when they are announced and to make comments, suggestions, or even propose new approaches to the problems. We are well aware of the importance to the nuclear power industry of the decisions the AEC must make. To the extent possible, we would like to be assured that the plans finally adopted represent the best that can be devised, and are in the best interest of the nation.

Now a word on procedure. In response to industry suggestions, the proposed plans relating both to the relaxation of the restriction on the enrichment of foreign uranium and on disposal of surplus AEC uranium will first be issued as a press release inviting comments and suggestions. Following receipt and review of these, a notice incorporating such revisions as seem appropriate will be published in the Federal Register, again providing amply opportunity for comment.

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-- URANIUM IN THE SEVENTIES --

A CANADIAN PRODUCER'S VIEWPOINT

I welcome this opportunity to talk with you about a common interest, -the mineral uranium and the development of its potential as a primary energy resource. The development has just begun; but at a rate that has exceeded even the most daring expectations of the proponents of nuclear energy.

This rate of acceptance of nuclear energy for electric power generation creates a market environment quite different from all previous experience of utility company and uranium producer. New situations, in which some factors are not clearly definable, can lead to incomplete understanding between producer and consumer. It is quite possible, gentlemen, that this condition now exists between some European utilities and Canadian uranium producers. I express today the viewpoint of a Canadian producer; I will describe the advantages we can offer Germany in energy resources and the challenges we face. In turn, I hope during my visit here and in subsequent visits to your country to acquire a deeper understanding of your viewpoints, your concerns about uranium and the challenges you face.

The number of nuclear units in various stages of construction or on order, plus tentative plans for others, already makes an impressive total. In North America alone the number exceeds 100. This nuclear commitment leaves little doubt about the acceptance of uranium as a competitive fuel. The outlook in Germany also is bright; I am told by various informed sources in your country that by 1980 there will be 20-25,000 Mwe. in operation and the cumulative U308 requirement could then be in the order of 40,000 tons. I understand that Dr. Liebruck later today will discuss in some detail the outlook for energy consumption and power generation in Germany and I look forward to his analysis. The rate of growth in Germany will place it in the first rank for nuclear commitments, and make it the third largest world market for uranium.

Uranium Sources:

In the decade now dawning more uranium will be required by utilities than was produced prior to 1970 for all purposes. Where will it come from? It is evident that few countries will be self-sufficient. In fact, most reserves are found in four countries, -Canada, United States, South Africa and France. The African countries, Gabon, Niger and

Central African Republic account for more than half the remainder. Although this distribution is not likely to remain static, the United States and Canada can be expected to maintain their leading positions because of the intensive effort, exploration skills and favorable potential in North America.

Canada, with large reserves in excess of domestic requirements has an unique position, - a position which should be of real advantage to German utilities as they seek assurance for their long term needs. The principal Canadian reserves are in precambrian quartz-pebble conglomerates in the Elliot Lake area of Ontario, a famous area which is the home of the Denison mine, the largest single uranium deposit known. Canada has many other areas of great potential and the search is both intensive and wide-ranging. I believe it reasonable to expect a common bond to be established between Germany and ourselves. Our interests are complementary. We can help to provide the uranium that will be needed for German power plants. Above all, we can assure long continuity of supply.

Production Rates:

We already have many points of agreement with utilities. Foremost is that a very high level of production, - much higher than the present level, - will be needed to meet the uranium requirement of the seventies. To be more specific, the present annual output of all world* producers is about 23,000 tons U_3O_8. How does this compare with early demand? In late October of this year the United States Atomic Energy Commission published revised estimates of world uranium requirements. Their current figures indicate demand growing to 34,000 tons per year by 1975, 72,000 tons per year by 1980 and 124,000 tons per year by 1985. Estimates by European agencies (ENEA) for the same periods are higher; for example for 1975 they estimate a world requirement of at least 40,000 tons per year. In your own research, some of you may have developed somewhat different estimates — possibly even higher ones. But whatever the criteria, the mining industry is presented with an enormous challenge to increase production rates in a very short time. And time is a key factor in meeting the challenge. Within weeks we will be entering the decade of the seventies, - an era of great promise, - an era of critical importance to energy development here and in North America.

I have given first importance to annual production rates because it is nuclear fuel, not ore reserves, that will be needed by your reactors. Ore reserves give continuity to production but reserves, however large, will be no comfort if production facilities are not ready in advance of your reactor needs. There are physical limitations that must not be passed over hastily. Ore reserves are not 100% recoverable; in

* excluding communist countries

most cases 80% extraction will be maximum. An increase in the rate at which reserves can be extracted is directly dependent on an increase in processing capabilities. It follows, then, that incentives must be attractive to stimulate the creation of new production facilities and the expansion of existing plants. Attractive incentives mean selling prices that will give a satisfactory return on the capital that must be invested to create the facilities. For mining companies the return on investment must take into account the high risk inherent in mineral search and mine development. It is not unreasonable, in view of this risk, for investors to require a return higher than for other business ventures.

Objectives:

The previous speakers, Dr. Wilke and Dr. Hampel, have reported very thoroughly on uranium deposits and on exploration methods and I have been asked to speak about problems of future supply. I prefer to refer to them as the challenges of future supply. A distinguished management consultant, Peter Drucker**, points out that results are obtained by seizing opportunities, not by solving problems. Resources, to produce results, must be allocated to opportunities, rather than to problems. Mr. Drucker does not advocate shrugging off all problems but he does emphasize that the real question is how to find the right things to do, and to concentrate resources and efforts on them. What, then are the right things for the mining industry to do? What are our objectives? I will try to set them out clearly. This will be helpful I think, not only in defining our challenges but in showing how closely related our objectives are to the objectives of utility companies. These are the things I want to talk about today. Also I cannot overlook frank consideration of the market stages through which the industry will pass. Agreement on common objectives and on probable market patterns can be the first step toward effective action to offset potential problems of supply and demand.

The mining industry has three basic objectives:

- First, to ensure that adequate uranium reserves are found and developed.
- Second, to create the physical means to produce uranium concentrates at a rate and price which will satisfy the requirements of the utility companies.
- Third, to obtain a favorable return on money invested.

Obviously, the effort expended on the first two objectives will be directly dependent on the third objective, - i.e. the outlook for invested capital.

Uranium supply has a different meaning for the producer

**Managing For Results ... P. Drucker 1964

than for the consumer. Electric utilities are concerned with low fuel costs and continuity of supply; for them uranium fuel is simply one factor in the cost of producing the final product --- electric power. To the mining company, uranium --- as a concentrate or partly-processed fuel, --- is a final product. The mining company's paramount concern must be to obtain a favorable rate of return on money invested in finding and producing uranium. A balance must be found between the fuel costs objectives of the utilities, and the financial objectives of the mineral producer.

In the seventies we must expect serious supply problems if producer and consumer allow uncertainties about each other's policies to defer positive action on fuel supply. And without doubt uncertainties will delay development of new orebodies if short-term, wait-and-see policies continue to prevail in Europe. Indeed I believe we are now in a critical period for decision-making. No misunderstandings on these points should be allowed to persist.

Market Stages:

We must expect that the uranium market will pass through four predictable stages. Let us examine the characteristics of each stage and the alternatives that are open to buyer and seller.

1. - In the first stage, just recently concluded, production rates were in balance with demand, and there was unused capacity. This was the doldrums, - the interim period between the military market and the industrial market. The industry's heritage from this stage is a strong position in ore reserves and established production facilities. Indeed, the world enters the new nuclear era with great advantages.

2. - In stage 2, current production rates will exceed current consumption rates. Temporary oversupply will result from the phasing-out of government stockpile contracts and the rejuvenation of mines in preparation for increased demand. The industry is in this stage of temporary over-supply now.

3. - In stage 3, production rates and demand will be in very close balance with production facilities operating at maximum or near-maximum capacity. This is the healthiest stage for the nuclear industry, - one which will be reached in the early seventies. This is a stage which we must attempt to

prolong by incentives for the expansion of production capability.

4. - Stage 4, in which production rates will be insufficient to meet the requirements of all consumers, should cause all of us real concern now; it is quite certain, in my view, that we will reach this stage well before the end of the new decade, - possibly by mid-decade. Its effects are predictable, but they can be deferred, - possibly even offset, - by positive action in 1970-71. Stage 4 will be reached much too soon if there is failure to take early action to stimulate capital investment in production facilities.

The Current Stage:

The characteristics of the current stage, - stage 2, are temporary oversupply, price uncertainties and shadow boxing by consumer and producer as they attempt to gauge the rate at which needs of the utilities will develop and the ability of the mining industry to find more uranium ore. But shadow boxing is no substitute for action. Much attention has been centered in the last four years on these important factors. Much less attention has been given to the key element, incentives for increasing production rates in the 1970's. During stage 2 it is understandable that there will be some quantities of uranium offered for early delivery at unusually attractive prices. In fact, prices are being offered by some producers at slightly above operating costs. Why? Because some companies must have immediate revenues; they are sacrificing long-term development and exploration. And it is possible for one to be misled into concluding that these prices are representative of what the market price should be, and hence a base for determining price levels in the continuing market.

We must be realistic about current conditions. This is a transitory stage whereas the operating life of reactors will be concurrent with stages 3 and 4. I believe that we must all be vitally concerned with establishing optimum conditions, insofar as we can, to offset future supply deficiencies and the unstable prices characteristic of stage 4.

I am convinced that it will be to the best advantage of all participants to ensure that stage 3 is not also short-lived. Our resources must be allocated to opportunities. The future is being made today, largely by decisions you and we are now making.

Meeting Objectives:

I have emphasized that the objectives of the mining industry

are to find and develop adequate reserves and to create the physical means to produce uranium concentrates. You are aware by now of how much emphasis I place on economic incentive for attainment of these objectives. Because we ask for action by utilities it is fair to ask some questions of the mining industry:

- What is our industry doing about its objectives?
- What results can we report?
- What will be effects of new discoveries?
- What factors will affect their development?

As one concerned with these questions daily, I can say that the response to the challenge of finding new uranium deposits has been action on a massive scale. Effort, money and skill are being applied logically, thoroughly and intensively. This response has been spurred, not by current prices and consumption rates, but by the shape of the demand curve for the seventies and the expectation that economic rewards will justify the vast expenditures of money and effort. In North America nearly every major mining company has a uranium exploration program; many oil companies with their vast resources have joined the search. The interest is international; European and Japanese companies are active participants, often in joint ventures with North American mining companies. As an example, Denison has joint projects in several areas of Canada, the United States and Guyana. International participants in our projects include the utility companies of Japan, several American oil and mineral companies, and Somerin of Italy. Denison is applying its resources to finding new deposits because the opportunity must be grasped now. Our assessment is that the nuclear industry will need much, much more uranium than we and other producers can deliver from existing orebodies. And our partners in joint ventures share this strong belief.

Exploration programs, especially in new areas, must be carried out in several phases spread over several years. The time factor, of course, is a most important element and there really has not yet been sufficient time for most programs to reach advanced stages. Discovery holes of undetermined potential have been reported by some companies but confirmed tonnage estimates are lacking. We must wait for more information before any objective assessment of possible new reserves can be made. Undoubtedly, the lack of early spectacular results is bringing the sobering realization that new deposits will be even more difficult to find than was generally expected. More time and additional expenditures will be needed. But if new discoveries continue to lag in 1970 and major utilities persist in reluctant supply policies, we can

expect a deferment of massive effort. Reluctance to commitment on the part of utilities certainly will have a cooling effect on exploration effort. I believe this already is happening. Indeed, this cooling of effort may well be too rapid for the best interest of the nuclear industry.

The Effect of New Discoveries:

Will exploration effort result in temporary oversupply through the seventies? I think not. As I have pointed out, supply is dependent on production facilities. It is unlikely that new deposits will be developed and new concentrators built until there is reasonable assurance of profitable operations. The view has been expressed that discoveries of large deposits will keep the selling price of uranium depressed to current levels. In my opinion this is an erroneous view for the expanding market we all envisage. Of course, large high grade orebodies, if not geographically remote, will be more profitable than the average mine. Such deposits are rare indeed, and if discovered will not be numerous enough to "take-over" the huge market of the seventies and eighties. Average grade deposits will be needed. The economics of average deposits in the seventies will have far more effect on price than will occasional "super-deposits". More uranium deposits --- and good ones --- will be needed. Their effect will be to increase the supply of reasonably priced uranium; this is one of our basic objectives. Existing Canadian deposits, --- in particular Denison's massive orebody, --- can play an important role in stabilizing price and supply.

Development of New Discoveries:

International interest is focussed on exploration efforts; there is great eagerness for the "bonanza" in a new area. I do not doubt that new discoveries will come; this is what gives mining its great fascination. After the initial enthusiasm, new discoveries must be probed and their economic potential thoroughly examined. Only then can financial and production decisions be made. Even before discovery we know certain economic facts about potential areas. We know for example that some promising areas are geographically remote; deposits in these areas must be numerous or large or high grade to support the costs of remoteness. Only the most exceptional deposits in these areas will be able to operate profitably in the mid-seventies, because of the cost of providing new services, transportation, accommodation and supplies.

Will mining face special problems in northern areas? Yes, there will be disadvantages but I do not foresee unusual operating or technical difficulties. Surface and underground operations can be successfully carried out in a northern climate throughout the year. The real problem there will be additional construction and operating costs that mine operations must support. Of course, not all new deposits will be in remote areas. There is much new effort in familiar established districts. There,

problems of new mines will be mainly those of costs associated with greater mine depth. New deposits in these districts are likely to be deeper, harder to find, and to require underground operations.

Areas with favorable potential for uranium deposits are not restricted to North America, of course. In some mineral-rich developing countries the political and resources investment climate is so unsettled that it poses a principal obstacle to exploration and mining development. Political unrest, high taxation, the possibility of expropriation and artificial exchange rates are the principal deterrents. Canada, with a long history of political and economic stability and fortunate in its mineral potential, will continue to be a reliable long-term mineral exporter.

A recent study* has detailed cost comparisons for uranium produced in new plants versus existing plants. Three examples were considered: 1) "First-generation" plants which have survived from the early 1960's. 2) "Second-generation" plants which have existing reserves but no plant and 3) "New-generation" plants which must find the reserves and come into operation in virgin areas dependent solely on the free market. For a surface mine with 20,000,000 lbs. reserves the author finds that uranium from the "New-generation" plant will cost $2.75 per pound more than from a "First-generation" plant. The "Second-generation" plants will have costs approximately $1.00 per pound higher than the "First-generation" plants. Although this is a specific example and not universally applicable, it does attempt to quantify the cost advantages of the established mine and the additional cost per pound that must be borne by a new mine.

Methods:

Mining methods for uranium ore are similar to those used for other mineral deposits of comparable geometry and mineral value distribution. There will be much more extensive use of large, versatile mechanical equipment in underground mines to partially offset rising labor costs, and to provide more attractive work conditions. Underground ventilation will be more costly because of the high air requirements of diesel engines. Can we look forward to technological innovations in mining that will offset rising cost trends? Yes, to some degree we can. But many underground mines do not lend themselves readily to the use of large equipment. The miner is faced with the need to break and move ore through several stages and through restricted passages. This requires the efforts and attentions of a relatively large labor force. The underground miner must cope with restrictions that limit choices in method and scale of operations.

*"Evaluation of Uranium Ventures" by N.A. Grant, Getty Oil Co. Feb. 1969

I do not wish to give the impression that the mining industry will move forward reluctantly with technological improvement. On the contrary, the industry is more receptive to change, and is changing its methods faster, than at any time in my experience. In surface mining where limitations are fewer, there have been remarkable advances in productivity. In spite of our present enthusiasm for technological change, I must say quite frankly that physical restrictions inherent in most underground mines will limit its effect to a rate that will not compensate fully for rising production costs.

I do not foresee any radically new developments in ore processing methods. New uranium mills of the seventies will differ only slightly from present mills. Ore beneficiation circuits to discard the barren fraction of the mined ore, and improve the grade of the ore before it is fed to the mill circuits, hold promise. Some progress in this approach can be expected. The best promise for cost reduction lies in large scale of operation, and in plant operations at full capacity.

Government Limitations:

I have emphasized that we, with large exportable reserves, can offer German consumers stability of supply on long term conditions. Indeed, German utilities at present have a certain advantage, resulting from the dual uranium policy of the United States. As you know, American uranium can be sold to foreign countries but foreign uranium cannot be imported for domestic use into the United States. An announcement about removal of this restriction is expected this month. Current American policy hinders the normal development of the uranium market. Unless this restriction is soon removed, or substantially eased, the result will be great pressures on supply and prices when American utilities are free to purchase uranium in the international market. In my view the size and growth rate of the U.S. market make it inevitable that Canadian uranium will be needed. The intense activity of American mining and oil companies in Canadian exploration is recognition of that need.

How does this affect Germany? An articifial condition in the uranium market is created when the principal consumer is excluded. A disorderly market condition will result when that consumer re-enters the world market at a time of impending undersupply. If German utilities do not grasp the opportunity to act while United States buyers cannot make foreign purchases, they must be prepared to compete with them for available supplies in the mid-seventies.

Construction Progress:

I would not be entirely frank in my comments today if I

were to disregard several disquieting trends in reactor construction progress which have caused much concern this year. Time will permit me to mention briefly only a few of the highlights. Concern centers mainly on the economic effect of construction delays caused by manufacturing difficulties, and on capital cost increases. Public concern about urban plant sites and thermal effects also have come to the foreground this year. But these are growing pains. None present insurmountable barriers, - technical or economic. The principal factors which led to enthusiastic adoption of nuclear power have been vindicated. They were:

- the need for clean new fuel sources
- the need for additional safe, reliable generating sources
- the advantage of site independence from fuel source
- low cost energy

All these expectations have been achieved except for slowness of acceptance by the public of urban siting. As more nuclear plants come on stream successfully, operating experience will counteract public uncertainties. We can expect, with confidence, that current delays will be overcome. Indeed several of the largest utilities in the United States have privately expressed to me their confidence in an enlarging nuclear commitment for their companies. Additional power and a healthy environment are compatible goals. Indeed, the advantage of nuclear power is that it has much less effect on the total environment than other sources of energy.

A Producer's Response:

I have made the observation that resources, to produce results, must be allocated to opportunities. At Denison we have accepted this challenge and have undertaken a planned program of improvements coupled with long-term mine development projects. We have concentrated on improving each of the principal elements in the mining cycle including:

- the drilling, breaking and ore handling
- the loading and haulage of broken ore

We have also completed a number of long underground excavations, "arteries" to provide access routes and ventilation passages for new areas of the mine. These large excavations are costly but essential for the development of the mine in accordance with our long-range plan. Much new equipment has been installed. This includes new leaching facilities

in the surface plant, high-capacity conveyor network, an underground crushing station, large loading and haulage units as well as new equipment for our drill crews.

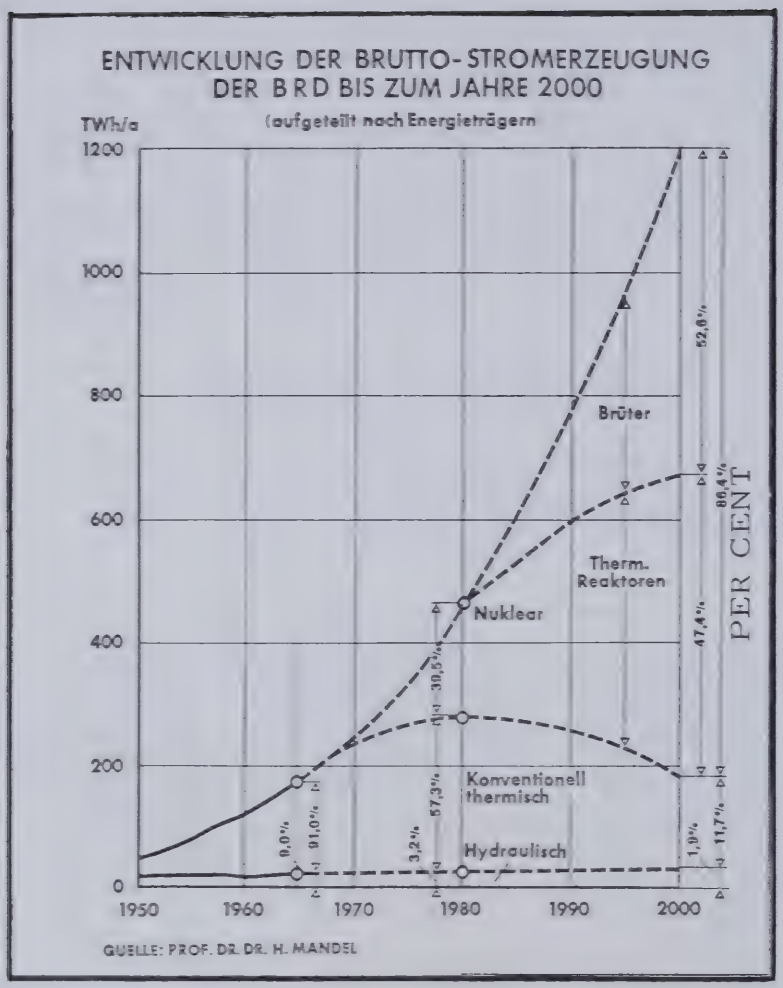
In brief, we are applying our resources to:

- provide capability for expanded production
- open large new areas of the mine for development
- reduce operating costs and offset rising cost trends through gains in productivity.

We have committed our resources to a program of preparedness for the seventies through these actions and through our exploration efforts.

In conclusion, gentlemen, I want to confirm my belief that we and utility companies have similar objectives, - we have many points of agreement, and we both face great challenges in the seventies to meet our objectives. The mining industry is meeting the challenge with massive action to find the needed ore reserves. But this is not the full answer. Effective action to increase production capabilities is highly dependent on future purchase commitments by utilities. I hope that frank exchanges of views will help us to reach mutual agreement on the action needed for the seventies.

It will be a fascinating period. We look forward with you to its challenges.



DEVELOPMENT OF TOTAL ELECTRIC ENERGY PRODUCTION

TO YEAR 2000

FEDERAL REPUBLIC OF GERMANY

*TWH/A = BILLION KWH/YEAR

BRUTER.....BREEDER

THERM. REAKTORREN.....THERMAL REACTORS (NUCLEAR)

KONVENTIONALL THERMISCH.....CONVENTIONAL THERMAL

HYDRAULISCH.....HYDRAULIC

SOURCE: KERNENERGIE.....COMMERZBANK - BRANCHEN BERICHT 1969

REASONABLY ASSURED URANIUM ORE RESERVES

TABLE 1

Price Range U3O8	A Reserves under $10. /lb.	B Additional Reserves $10. -$15. /lb.	A + B
United States	180,000	100,000	280,000
United States (by-product)	120,000	50,000	170,000
Canada	200,000	130,000	330,000
South Africa (by-product)	205,000	65,000	270,000
Sweden	---	350,000	350,000
Others	121,000	85,000	206,000
TOTAL (tons)	826,000	780,000	1,606,000

Source: ENEA - December 1967

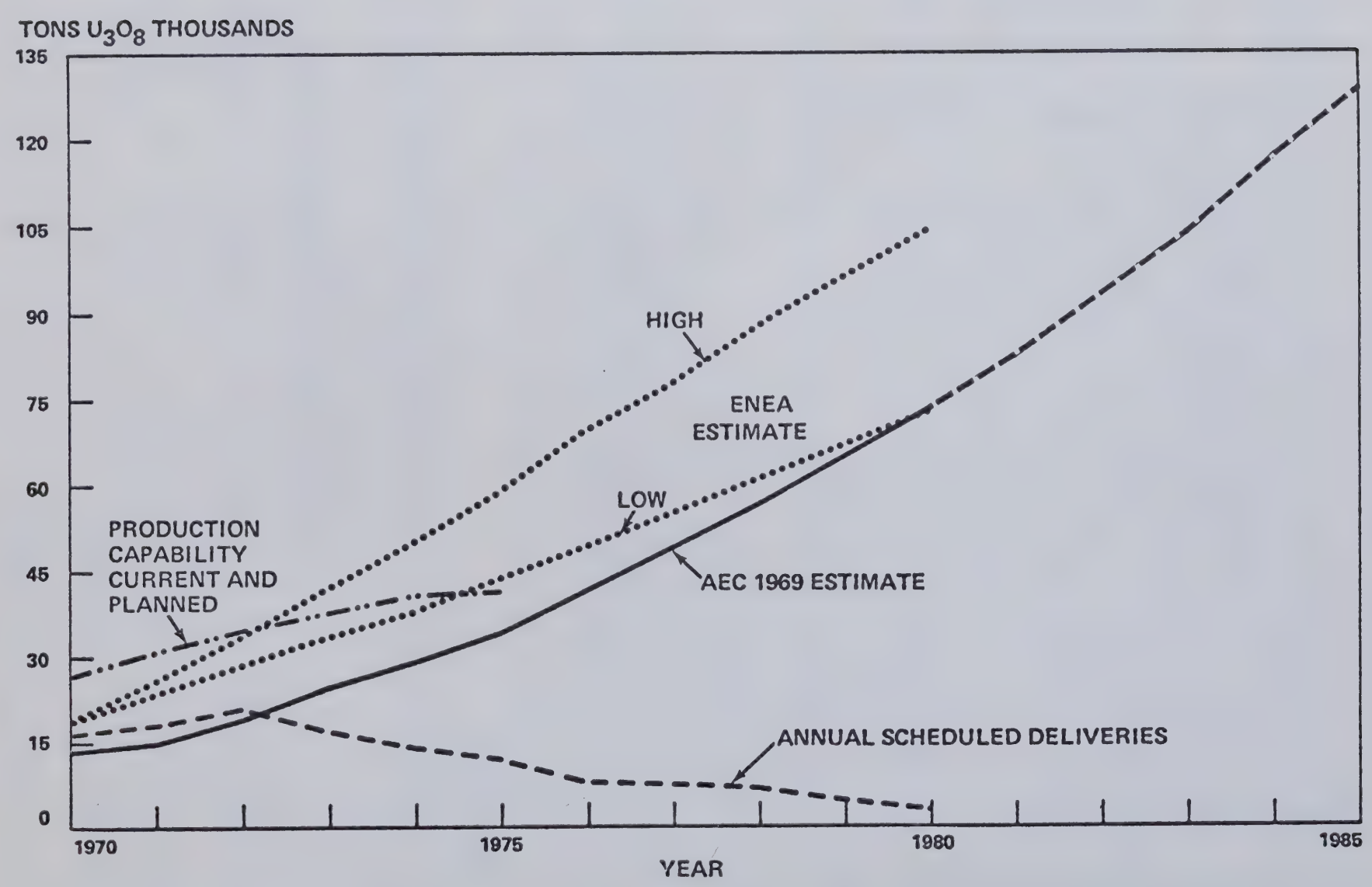
Note: A later ENEA report (January, 1969) shows an ore reserves total of 700,000 tons U3O8 under $10. per lb. This results from exclusion of United States by-product reserves which will become available only at a relatively slow rate.

TABLE 2 *

	U3O8 REQUIREMENTS TO 1980 (Short Tons)		
	United States	Other Countries	Total
Cumulative Consumption	264,000	166,000	430,000
+ 10 year reserve	397,000	274,000	671,000
TOTAL REQUIREMENT	661,000	440,000	1,101,000

* U3O8 - The Outlook for Uranium - by the Energy Division, Chase Manhattan Bank. - March, 1969 N.A. -

ANNUAL FREE WORLD URANIUM REQUIREMENTS
SCHEDULED COMMERCIAL DELIVERIES TONS U_3O_8

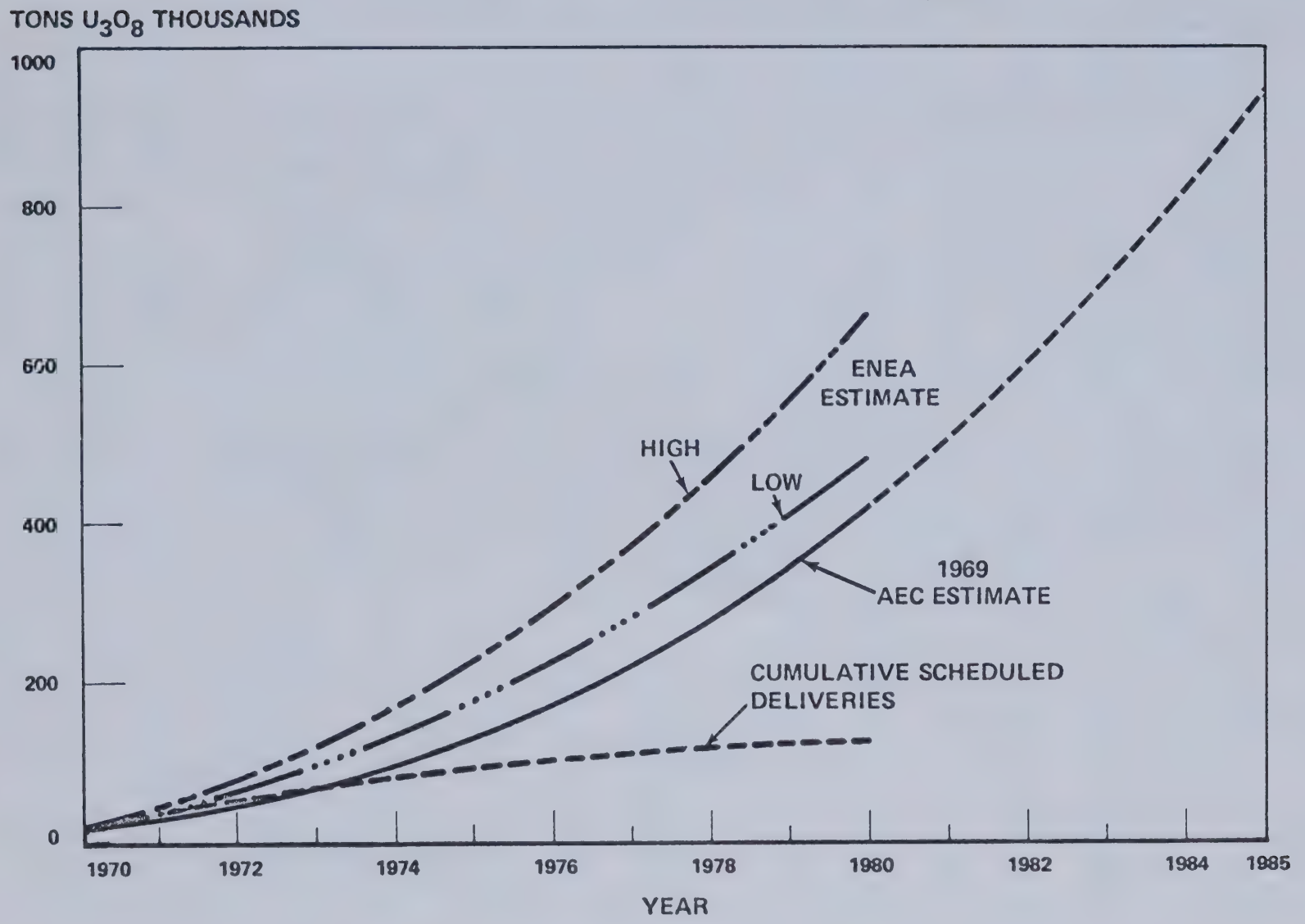


Source: USAEC

Figure 6

October 1969

CUMULATIVE FREE WORLD URANIUM REQUIREMENTS
SCHEDULED COMMERCIAL DELIVERIES TONS U_3O_8



Source : USAEC

Figure 5

October 1969

NUCLEAR POWER PLANTS IN THE FEDERAL REPUBLIC OF GERMANY
Kernkraftwerke in der Bundesrepublik Deutschland

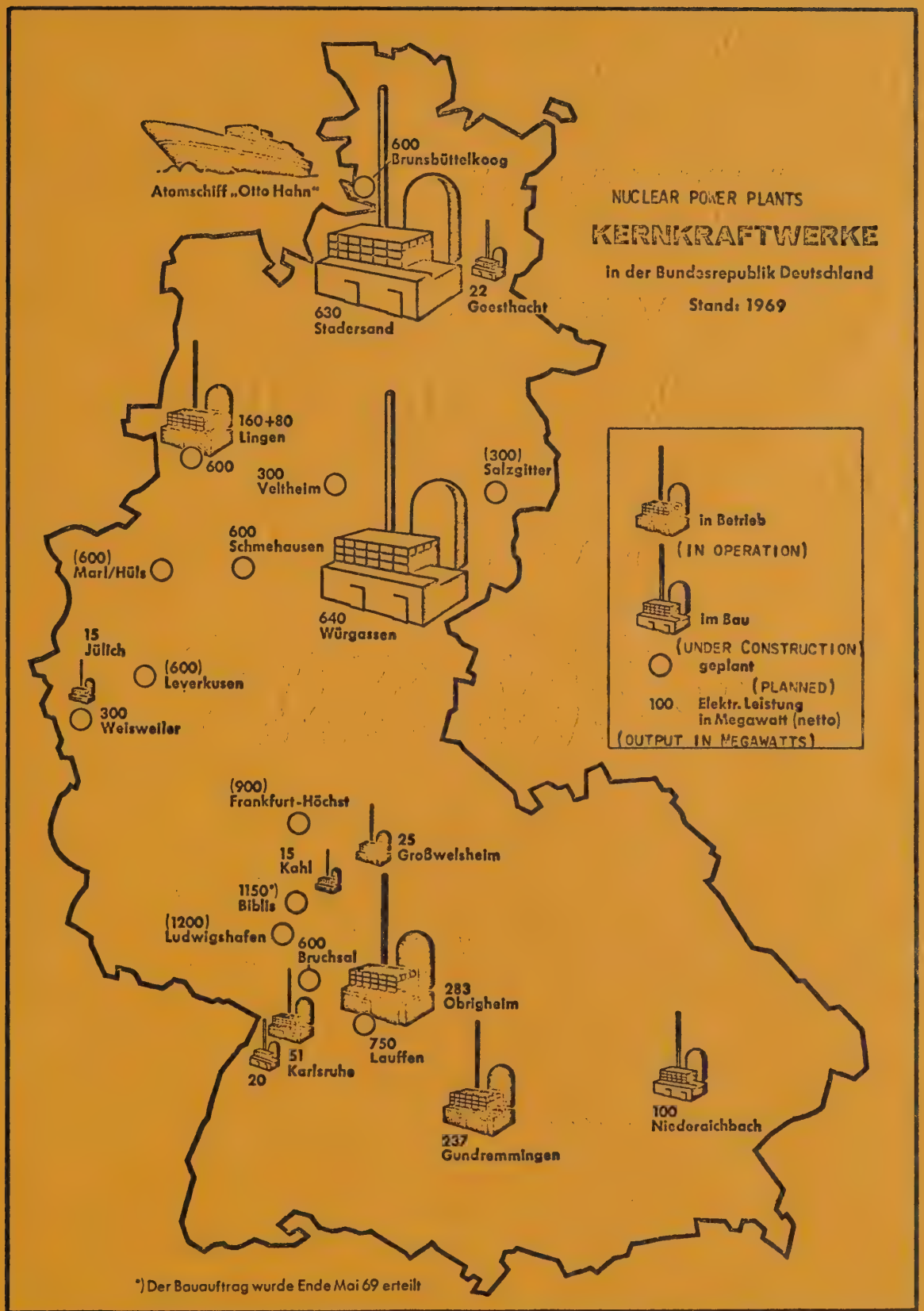
	Lfd. Nr.	Bezeichnung	Standort	Nettoleistung MW_{el}	Reaktortyp	Hersteller	Eigentümer	Betreiber	Gesamtkosten*) Mio. DM	Vorwiegende Finanzierung durch	Inbetriebnahme
UNDER CONSTRUCTION OR IN OPERATION	1	Versuchsatomkraftwerk Kahl (VAK)	Kahl/Großwelzheim a. M.	15	Siedewasser	GE/AEG	VAK-GmbH (80% RWE, 20% Bayernwerk)		40	Eigentümer	1960
	2	Mehrzweckforschungsreaktor (MZFR)	Kernforschungszentrum Karlsruhe	50	D_2O-Druckkessel	Siemens	Ges. f. Kernforschung mbH	Kernkraftwerks-Betriebs-GmbH (100% Badenwerk)	156	Bund mit Unterstützung des Landes Baden-Württemberg, der EVS und des Badenwerks	1966
	3	Kernkraftwerk RWE-Bayernwerk (KRB)	Gundremmingen (Donau)	240	Siedewasser	GE/AEG	KRB-GmbH (75% RWE, 25% Bayernwerk)		300	Eigentümer mit Unterstützung der öffentl. Hand	1966
	4	Atomversuchsreaktor (AVR)	Kernforschungsanlage Jülich	15	Hochtemperatur-Kugelhaufen	BBK	AVR-GmbH (mittlere und kommunale EVU)		100	Bund und Eigentümer	1966/67
	5	Kernkraftwerk Lingen (KWL)	Lingen (Ems)	250	Siedewasser mit ölbeheiztem Dampfüberhitzer	AEG	KWL-GmbH (VEW, AEG und Bankengruppe)		270	Eigentümer mit Unterstützung der öffentl. Hand	1968
	6	Kernkraftwerk Obrigheim (KWO)	Obrigheim (Neckar)	300	Druckwasser	Siemens	KWO-GmbH (EVS, Badenwerk und weitere südwestdeutsche EVU)		300	Eigentümer mit Unterstützung der öffentl. Hand	1968
	7	Heißdampfreaktor (HDR)	Kahl/Großwelzheim a. M.	25	Siedewasser mit integrierter nuklearer Dampfüberhitzung	AEG	Ges. f. Kernforschung mbH	HDR-Betriebs-GmbH (100% RWE)	90	Bund	*1969/70*
	8	Kompakte Natriumgekühlte Kernreaktoranlage (KNK)	Kernforschungszentrum Karlsruhe	20	Zirkonhydrid-Natrium	Interatom	Ges. f. Kernforschung mbH	Kernkraftwerks-Betriebs-GmbH (100% Badenwerk)	110	Bund	*1970*
	9	Kernkraftwerk Niederaichbach (KKN)	Niederaichbach (Isar)	100	D_2O-CO_2-Druckröhren	Siemens	Ges. f. Kernforschung mbH	KKN-GmbH (100% Bayernwerk)	205	Bund und Land Bayern	*1970/71*
	10	Kernkraftwerk Würgassen (KKW)	Würgassen (Weser)	612/640	Siedewasser	AEG	Preußenelektra		~400	Eigentümer	*1971/72*
	11	Kernkraftwerk Stade (KKS)	Stadersand (Elbe)	630	Druckwasser	Siemens	NWK mit HEW		~400	Eigentümer	*1971/72*
	12	Kernkraftwerk Schleswig-Holstein (KSH)	Geesthacht (Elbe)	25	Hochtemperatur mit Gasturbine im direkten Kreislauf	GHH	KSH-GmbH (Land Schleswig-Holstein)		~90	Bund und Land Schleswig-Holstein	*1973*
PLANNED	13	Geplant: Kernkraftwerk Lauffen	Lauffen (Neckar)	> 750	Leichtwasser	?	EVS, TWS, Neckarwerke		?	Eigentümer	*1973*
	14	Kernkraftwerk Biblis	Biblis (Rhein)	>1000	Leichtwasser	?	RWE		?	Eigentümer	*1973*
	15	THTR-Prototyp	Westfalen	300	Hochtemperatur-Kugelhaufen	BBK	westf. EVU		450 (?)	Eigentümer und öffentl. Hand	*1974*
	16	Schnellbrüter-Prototyp	Weisweiler	300	Natrium-Schnellbrüter	Internat. Konsortium	Internat. EVU-Gruppe		450 (?)	Eigentümer und öffentl. Hand	*1975*

	NUCLEAR PLANTS	LOCATION	NET OUTPUT	TYPE	BUILDER	OWNER	OPERATOR	TOTAL COST	MAJOR FINANCING BY	START-UP DATE

** DM = DEUTCHMARKS

*) Die Gesamtkosten umfassen die Anlagekosten einschließlich Bauherrenkosten sowie die Kosten der Erstausstattung mit Brennstoff und Moderatorstoffen; Forschungs- und Entwicklungskosten sind nicht eingeschlossen.

ATOMWIRTSCHAFT APRIL 1969



NUCLEAR POWER PLANTS IN THE FEDERAL REPUBLIC OF GERMANY

SOURCE: KERNENERGIE ..... COMMERZBANK - BRANCHEN BERICHT 1969

THE URANIUM CHALLENGE

By Stephen B. Roman

Chairman of the Board
Denison Mines Limited

I am pleased that this society is interested in knowing something about Denison Mines Limited and about its objectives, its intentions, and the challenges we see for the future.

Denison is a young company, born in unique circumstances in the early 50's. Our company has an interesting history, all compressed into fifteen years. It is a saga based on the romance of a great mineral discovery --- now one of the most famous in Canadian mining history. The discovery was famous for many reasons --- its size, its value and strategic timeliness. It was an essential mineral --- there were great incentives to searching for, and developing these deposits.

It was an exciting period --- a period of great challenges to the mineral industry --- a period of great personal challenge. But I will not dwell on times and situations now bygone. My interest is in the future, as I think yours is too, and I have a point to make before proceeding. The largest ore deposit of the many in the famous uranium district of Blind River - Elliot Lake - as you may have surmised --- was, and still is --- the Denison mine. And it was one of the few uranium companies to survive the post-boom era of the 1960's, that grey time between the military market for uranium and today's industrial market for nuclear fuel.

We will leave the reminiscing to journalists and historians. We are now in a new age --- an age in which nuclear fuel will be the source of peaceful energy in vast amounts. Let us look into how we can contribute and participate in the development of nuclear electric power in this new age. First we must identify the challenges --- and we must decide which ones we must face --- which ones are optional for us --- and which ones we are equipped to meet successfully.

First, I would like to tell you briefly about our Company's principal interests and resources, and then go on to describe our plans and expectations for the future.

Denison is, primarily, a mining company with uranium ore reserves much larger than those of any other company. These reserves are all in one mine --- the Denison mine --- located in the Elliot Lake district of northern Ontario. It is about 100 miles west of the great nickel district of Sudbury, and about 350 miles northwest of Toronto. The mine and mill have operated continuously since 1957 and have produced nearly 50,000,000 pounds of uranium concentrates.

During recent years, Denison has diversified into industrial activities and now has substantial interests in cement through its holdings in Lake Ontario Cement Company and Canada Cement Company. Our oil and gas division in Alberta continues to grow. Production last year was just under 1,000,000 barrels of oil and 434 million cubic feet of gas.

We have substantial investments in a number of mining companies and in mining exploration companies. Our major activities and diversification are set out in some detail in our 1968 Annual Report which is available here today.

Our objective in the last decade has been to establish a strong, broad base for our company. We expect --- and we intend --- Company growth and diversification to continue. Nevertheless, the Denison uranium orebody - with 300,000,000 pounds of uranium oxide still to be mined - is our greatest asset --- and it will be the key to the real growth of the 1970's. It will provide the revenues --- as it did in the early 1960's --- to enable us to grasp other opportunities of large scope in the natural resource and industrial fields.

FUTURE OF NUCLEAR POWER

So our future is closely bound to that of nuclear power. Most major electric utilities in the United States, in Canada and in other industrial nations have already committed themselves at least, partially, to a nuclear future. Japan is the outstanding example. There, Tokyo Electric, Kansai Electric and nearly all of the other electric companies are committed to major nuclear power programs.

You, gentlemen, have seen so many reviews on the future of nuclear power and the subject has received so much attention in business papers that I will repress my natural desire to talk to you at length with graphs and numbers. National and international agencies have clearly documented the acceptance of nuclear power. They have projected a truly phenomenal rate of growth.

Some detail, however, is necessary as a background to my remarks. Let me present some significant numbers to set out the uranium demand situation as briefly as possible:

1. established mines and mills - worldwide - have a present output of about 23,500 tons of uranium concentrates annually.

2. to meet consumer requirements, the annual production rate must increase to 40,000 tons (i.e. nearly double by 1975) --- it must double again to 80,000 tons annually by 1980.

Uranium consumption projections, of course, must be based on estimates of energy requirements, which are usually expressed in megawatts of installed capacity. Consider a large American reactor - say 1000 Mwe. size. As a rough yard stick to relate uranium consumption to megawatt output, let me point out that the first fuel charge is approximately 750 tons for such a reactor. The subsequent consumption for the same reactor is in the order of 200 tons of U_3O_8 annually. As the number of operating reactors increase --- and the trend is to larger units --- the annual uranium requirement will mount quickly. Uranium as an essential fuel for the future is evidenced by approximately 100 nuclear electric plants in the United States now operating, or in the planning stages. Their nuclear capacity will be 76,000 megawatts. By 1980, requirements will have reached 145,000 megawatts or more; approximately 40,000 tons of U_3O_8 will then be needed annually, in the United States alone. And the world demand is expected to be at least double this amount annually. *

More dramatically, --- using a current idiom --- we can liken this growth in demand to a rocket blast-off, --- slow --- massive and powerful as upward movement begins --- then rapid acceleration. And, really, this is not an idle comparison. We must not forget that we are still on the low end of the uranium demand curve --- the industry still has a production capability exceeding consumption. But this is a situation that will change and the mining industry must be ready for the acceleration in demand. We at Denison are ready --- ready by virtue of intensive effort since 1966 to prepare the Denison mine for high capacity production. And we are ready by virtue of our accessible ore reserves and our established plant.

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* Table 5 - Uranium - Production and Short-Term Demand by ENEA and IAEA - January, 1969

URANIUM MARKET FACTORS

Today, I want to express some of my views on certain factors and their effects on the nuclear industry --- and most particularly on the uranium producer. It is natural that there should be international concern about the adequacy of uranium reserves to satisfy the demand of the next decade and beyond. Reactor installations, although very economical to operate, are costly to build and they must have a life of several decades. And they must be refuelled regularly - and economically.

Worldwide growth in energy needs is inseparably linked to population. Population growth in the period 1965 - 1980 in the United States and Canada is estimated at 53,000,000 people. This alone will bring about enlargement of energy needs. But there is another population factor of great significance that is less generally realized --- this is the composition of the age-group structure of the population. Almost half of this increase will be young people - people in the age range 20 - 35. This is the family-formation age group which has the highest demand for the products and services of our society. It is clear that population and per capita use of energy will make unprecedented demands on the electric power industry in the decade just ahead of us. And nuclear electric power will be a chief source of that energy.

The world begins the new nuclear era with a good uranium reserves position. Most of the principal deposits are located in Canada and the United States. However, it is absolutely clear that additional reserves must be found to meet the vast requirements of the late seventies. Indeed, construction of the major additional production facilities that will be needed is dependent on success in the exploration and development of ore reserves, yet undiscovered.

THE DENISON MINE

But let us get back to Denison and be specific about its outlook as a company in this expanding market.

First, our orebody, while not as high-grade as the typical U.S. deposit, is very large --- at 300 million pounds it is nearly as large as all the known U.S. deposits together. Our present annual mill production capacity if 6,000,000 pounds of uranium oxide. We are considering eventual production rates of 9 - 10,000,000 pounds annually for which major capital additions to the surface plant would be needed. The present production rate is 4,000,000 pounds per year. You can readily see that the mine has a long life, whatever the production rate is or will be.

But potential production rates have little meaning unless we --- as a company --- can produce and market uranium profitably in world competition. Denison is particularly strong in this respect. Indeed a cornerstone of our marketing policy is the ability to enter into long-term contracts --- contracts as long as 30 - years --- which will ensure utility companies continuous supplies of uranium fuel at competitive cost. Few, if any, uranium suppliers today have the resources to do this.

This concept has been accepted by the Japanese utility companies with whom Denison has ten-year contracts for 21,000,000 pounds of uranium concentrates. Deliveries begin in July of this year. Most of the processing and enrichment will be done in the United States.

We are also delivering to the Canadian government stockpile and have made shipments to West German companies.

Where will our next markets be? Firstly, we expect developments in Europe. Although long-term supply contracts have not developed as quickly as originally forecast, the market is there. There has been a definite bias to short-term purchases. We expect a longer-term outlook to prevail, however. Japan will rely heavily on nuclear power and must import all its uranium. They have taken a long term view of the market. After detailed study of world resources they have taken positive action, in the form of 10-year contracts for a portion of their needs.

The United States, of course, is the most advanced nation in the use of nuclear electric power and at least one-half of the world's uranium produced before 1980 will be needed in the United States. In the near-term the proportion is even higher and I will have more comments on this point later.

MEETING THE DEMAND

There are several significant questions which naturally flow from the prospects of a rapidly expanding market. A market which is solidly rooted in two factors --- population growth and industrial development. The factors which are fundamental in the growth of national economies.

Questions frequently asked are:

- will there be enough uranium to meet the market demand at a reasonable cost?

- where will it come from?

- will there be an oversupply that will depress the market?

- how will Denison be affected by market factors --- in particular, by new ore discoveries by other corporations?

For the first question, the answer is short. Most of the world's known economic uranium reserves are in Canada, the United States and South Africa. South Africa's uranium is a by-product of gold mining which will limit production from that country.

Canada and the United States, then, are likely to be the principal suppliers for some years --- followed by uranium from new deposits in other parts of the world where Canadian and American companies are now active in exploration.

Nearly every major mining and oil company in Canada and the United States entered the search for uranium reserves. The result is that --- in comparison with the original boom of the 1950's --- more money, --- more drilling --- and many more skilled people are involved in the search.

Denison is one of the most active companies in the search for new orebodies. It is fair to ask. --- Why do we need to be? --- Why not limit our exploration effort and rely on our massive Elliot Lake reserves and established facilities? Very bluntly, gentlemen, the market is going to need much, much more uranium than we and all the other producers can deliver from existing orebodies. We have the skilled people, the technology, and the financial strength to participate in the nuclear market beyond the capabilities of our present mine. And we are not alone in this concept of the market; we have found great interest and desire on the part of major international companies to participate with us in this search. We have good partners in joint ventures in Canada, the United States and South America.

- Principal electric utility companies in Japan are jointly exploring with us in Colorado and in British Columbia.

- Atlantic Richfield Oil and International Mining Corporation are with us in the exploration of more than 1,600,000 acres in northern Saskatchewan, well known as the Wollaston Lake area.

- Very recently we began a joint venture with Phillips Petroleum Company for exploration of more than 827,000 acres in northern Saskatchewan, southwest of Wollaston Lake.

- The great ENI group of Italy, through its SOMIREN arm, is our partner in exploration in Wyoming and Montana. And I am happy to announce that we have just concluded two important new agreements with SOMIREN for other areas. Our joint search for uranium and other minerals will now extend to Guyana, South America; and to the Cambrian Lake area of Quebec.

These are major programs. They can involve exploration expenditures by the participants of more than $9,000,000. Two others are in negotiation now. All provide for the development of uranium ore deposits that may be found. This is concrete evidence, gentlemen, that mining and oil companies, with skilled staffs to evaluate mineral ventures, have confidence in Denison's leadership in mineral exploration and mine development. This is true also of our Italian and Japanese partners who are willing to enter risk ventures with us in North America to help assure their countries of a uranium supply. These companies and countries have recognized the importance of action today for tomorrow's needs.

THE EFFECT OF NEW DISCOVERIES

We come now to the question of whether all this activity, by ourselves and others, may result in temporary oversupply. It has happened with other minerals. Let's consider the effects of possible major discoveries of uranium. All segments of the nuclear industry, utility consultants, banks and investment houses agree that new deposits must be found --- but some have expressed the view that discoveries of large deposits will depress the selling price of uranium oxide. I must disagree with this view.

The market price must be based on the costs of producing uranium plus a profitable return on investment. In the cost of production I include, of course, the cost of finding and developing the orebodies and amortizing plant facilities. Large, high grade orebodies, if not geographically remote, certainly will be more profitable than the average mine. Such deposits are rare indeed, and if discovered will not be numerous enough to "take-over" the huge market of the 1970's and 1980's. Average grade deposits will be needed. The price for the uranium they produce must be an attractive incentive to its finding and exploitation. The economics of average deposits in the growing market of the 1970's will have far more effect on the selling price of uranium than will occasional "super-deposits" that may be discovered. Canadian deposits -- in particular Denison's massive orebody -- will play an important role in stabilizing the price and supply of uranium internationally. I do agree, however, that several such super-deposits would reduce the "scarcity premium effect" on the future selling price of uranium - and delay the need to mine high cost reserves. More uranium deposits --- and good ones --- will be needed. Their effect will be to increase the supply of reasonably priced uranium. Certainly, the effect will not be to reduce the available supply by driving out less profitable producers. This could happen in a contracting or static market but not in the market we envisage for the future.

I will admit, gentlemen, that I am concerned --- I am concerned that we have not reached enough people with this viewpoint. I say this because some people in the investment field, and some investors, have expressed uncertainty about uranium's price prospects as a result of rumored or reported discovery holes. We must expect that there will be new discoveries. There is a need for them to support a stable uranium market. We seem to see, at times, a paradox: A natural impatience of some investors for the immediate "bonanza" --- followed by anxiety that the bonanza will result in depressed conditions for established companies. Gentlemen, I am firmly convinced of the need for a massive exploration effort by the mining industry. We and other major companies are not going to withdraw our efforts as the result of rumored discoveries --- or even by future proven "super-deposits". If the market were that limited we would be putting our exploration funds and efforts elsewhere now. I have given you my response to this outlook --- and I would like to sum up by repeating to wavering investors: "Let's not lose sight of the objective --- we must press for the timely development of enough uranium resources to meet the demand of the "seventies and eighties".

U.S. RESTRAINTS ON CANADIAN URANIUM

The United States has made outstanding progress in nuclear technology for electric power generation. In this field, as in many others, it has been a world leader. American technology and nuclear reactors will be predominant internationally. The export market for them is important now to U.S. manufacturers. It will grow rapidly. There is excellent access to the export nuclear markets for United States products - and of course this is as it should be.

But if we look at the international nuclear situation more closely we find restrictions imposed by United States policy --- restrictions that create a one-way flow in uranium supply. United States industry is free to sell uranium in foreign markets. But foreign producers do not have reciprocal rights --- domestic uranium only can be used in the United States. This restriction on Canadian and foreign imports will apply until mid-1973 unless Congressional action permits earlier easement. We have been hopeful about early removal of the restriction. In fact, Atomic Energy Commission officials clearly stated in 1967 that the matter was under review. But for 18 months there has been silence. Now it is time to express the discontent which all Canadian uranium producers feel at being barred from a natural market --- a market which should be open between neighbors. A good neighbor policy should be expressed through reciprocal markets in natural resources fields.

There is support for this view by consumers in the United States. This is clearly evidenced by deep interest in Canadian uranium. This has resulted in specific requests for quotations on uranium, conditional on easement of government policy. Canadian uranium will not be detrimental to American industry --- it will, in fact, contribute to a stable uranium market and assure utilities of a dependable long-term supply.

When the import restriction was imposed it was intended as a measure to help domestic mines survive the period of market stagnation, and to encourage exploration for new reserves within the United States. These aims have been achieved. In fact, favorable geological conditions have attracted so many American and foreign companies that the United States now ranks as the most actively explored area in the world for uranium. And U.S. producers no longer need market protection

to survive. In my view, the time is past due for the removal of this artificial restraint. U.S. consumers should have the advantage of choice; and the removal of the trade restriction now would contribute to the orderly development of a stable international market. The United States will need Canadian uranium. The fact that American mining and oil companies are so active in uranium exploration in Canada is recognition of that fact.

Canadian uranium producers must be able to compete with American and South African producers on the international market. But we are hobbled, unfairly in my view, by the import restriction. This is one challenge that we firmly believe is an impediment to the best interests of both nations.

COMMON OBJECTIVES

The mining industry has other distinct, but inseparable --- and inescapable challenges.

- Firstly, to ensure that adequate uranium reserves are found and developed in time.

- Secondly, to create the physical means to produce uranium concentrates at a rate commensurate with the requirements of the utility companies.

The uranium outlook, perhaps has a different meaning for the producer than for the consumer. Electric utilities are concerned with low fuel costs and continuity of supply; for them uranium fuel is simply one factor in the cost of producing the final product --- electric power. To the mining company, uranium --- as a concentrate or partly-processed fuel --- is a final product. The mining company's paramount concern must be to obtain a favorable rate of return on money invested in finding and producing the uranium. A balance must be found between the fuel costs objectives of the utilities, and the financial objectives of the mineral producer.

Timing could develop into a serious industry problem if producer and consumer, in the next year or two, allow uncertainties about each other's policies to defer positive action on fuel supply. And producer's uncertainties could delay development of new orebodies if short-term, wait-and-see policies prevail in the next two years. Indeed, the next two years will be a critical period for decision-making by producer and consumer. As producers we must be sure that no misunderstandings on these points are allowed to persist.

Uranium is an economical fuel and the utilities are concerned that its price not escalate sharply. We share this concern. As a company, we are taking positive measures through long-term contract offers, to assure continuity of supply to consumers at reasonable prices. But the effect of a change in price must be examined realistically. Somewhat less than 10% of total power generation costs are attributable to uranium oxide. A one-dollar per pound increase in price of U_3O_8 would be equivalent to .08 mill per kilowatt hour. If the cost of uranium were to increase from $8.00 to $10.00 per pound power generation costs would increase only about 1/6 of a mill per kilowatt-hour. When equated with advancing reactor technology, the price of uranium will not be a barrier to low cost nuclear power.

OUTLOOK FOR DENISON

I would now like to touch briefly on other factors that you as professional security analysts may consider important in appraising Denison.

First let me emphasize an aspect of uranium pricing that has not yet received due recognition. I refer to production costs from new mines. Most of today's uranium is the product of mines that were developed when conditions were radically different in terms of construction costs.

Denison's present uranium mining and milling facilities originally cost approximately $55,000,000. Today the same facilities would cost not less than $120,000,000. New mining and processing plants that will be sorely needed in the seventies must face costs with which established producers, with amortized plants, will not be burdened. This is a factor of tremendous importance.

Let me indicate in general terms the price that a new mine will need for uranium concentrates to obtain an adequate return on investment. A recent major study by a prominent oil company points out that a typical new U.S. uranium open-pit mine, would need a price of not less than $9.00 per pound. Indeed, the price would have to be $10.00 or over if there were typical royalty payments involved.

My point, gentlemen, is that Denison's modern and well-maintained, amortized plant facilities represent a very real --- very valuable --- advantage in a competitive market.

Secondly - lets look at the present stock market valuation per pound of U3O8 reserves for important uranium producers --- adjusting in each case so as not to include non-uranium assets. Based on present market price, Denison's uranium reserves are valued at approximately 40¢ (U.S.) per pound. Compare this with the reserve evaluation for other producers -

-- American Nuclear - $1.78
-- Federal Resources - $2.01
-- Getty Oil - 92¢
-- Kerr-McGee - $1.57
-- Rio Algom - 60¢
-- United Nuclear - $4.67
-- Utah Construction - $2.78
-- Western Nuclear - $2.73

I leave it for you to make your own assessment of this rather startling set of market figures.

As a third factor I re-emphasize the size and broad geographic scope of our exploration activities. Denison's active programs range right across Canada, through the western United States --- and extend to Ireland, Jamaica and South America. These projects are designed to provide maximum possible exposure to attractive exploration opportunities --- not only in uranium --- but also in other minerals. Denison is undertaking this through work on its own account, through investments in other companies doing exploration work, through participations in projects with associated companies and through joint ventures with outside interests. Quite frankly --- we are very optimistic about our exploration projects!

Speaking to this group it should be appropriate for me to make my fourth point -- and to conclude my formal remarks -- on the subject of earnings.

Earnings have increased in each of the fiscal years since 1965. For 1969 I am brave enough to project -- even at this early date -- that there will be a further earnings increase of approximately 5 to 10%. This will represent earnings in the range of $3.00 - $3.10 per share. This estimated increase is attributable to improved uranium earnings, and increased revenue from investments.

With the earnings base that has been established, we are confident that our vast uranium reserves, production capability, and other resources, will enable us to demonstrate outstanding growth in the 1970's and beyond.

PRODUCTION, RESERVES and FUTURE SOURCES of URANIUM

By John Kostuik
President, Denison Mines Limited

Presented at
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PRODUCTION, RESERVES AND FUTURE USES OF URANIUM

By John Kostuik,
President - Denison Mines Limited

The previous speaker has capably described the truly phenomenal growth in demand for energy from all sources. The basic factors, - population growth and industrial development, - which will create energy demand, are so fundamental to national economies that the ascending energy demand curve will be little affected by short-term factors.

Because of the economic and practical advantages of nuclear power and the degree of present acceptance by electric utilities there is no doubt that uranium will be a principal source of primary energy in industrial countries. And this will happen within a decade. Indeed, during this period it will be the fastest growing source of energy, capturing, for example, more than half the electric utilities' expansion in the United States by 1980.

The ready availability of energy sources from domestic and foreign resources is so essential to industrial nations that the long-range outlook for their adequacy is of prime importance. There has been international concern about the availability of uranium resources at reasonable cost to adequately support and foster the development of the nuclear power industry. Canada, fortunate in having established reserves and a potential in excess of any forseeable domestic demand, can confidently look forward to being a principal supplier to the industry.

World resources of uranium as they are known today are chiefly the result of exploration and development stimulated by the military market of the 1950's. During the survival years, before the arrival of the private market, the search for additional reserves faltered. And this is understandable. Now, intensive new exploration efforts are resulting from bright market projections.

WORLD RESOURCES AND WORLD NEEDS

There is a natural impatience for the immediate "bonanza" now that exploration interest is high. This is part of the fascination of our industry, - but other virtues are patience and persistence. On reflection, I think we realize that there has not yet been sufficient time for large scale exploration programs to reach advanced stages. These are well planned efforts with the active phases, - in logical succession, - spread over several years. The time factor is a most important element in exploration; - and lack of early spectacular results should not be a cause for apprehension.

A comprehensive review of world resources was prepared by the European Nuclear Energy Agency and the International Atomic Energy Agency in December 1967. The outlook at that time is summarized in Table 1.

REASONABLY ASSURED URANIUM ORE RESERVES

TABLE 1

Price Range U_3O_8	A Reserves under $10. per lb.	B Additional Reserves $10. - $15. range	A + B
United States	180,000 tons	100,000	280,000
United States (by-product)	120,000	50,000	170,000
Canada	200,000	130,000	330,000
South Africa (by-product)	205,000	65,000	270,000
Sweden	---	350,000	350,000
Others	121,000	85,000	206,000
TOTAL (tons)	826,000	780,000	1,606,000

These are reserves in the usual mining sense except where uranium is shown as a by-product, dependent on the production of another mineral. U.S. reserves as reported by the United States Atomic Energy Commission do not usually include uranium as a by-product of phosphoric acid production and copper leaching solutions. Output from South Africa, - a principal producer, - is mainly a by-product of gold mines, and is limited by an expected gradual decline in gold production in the middle seventies. These international agencies estimate that in the two categories (under $10. and $10. - $15. per lb. uranium oxide) there could be additional tonnages of roughly the same order of magnitude. But this is speculation and all observers including the compilers, have been cautious in placing any dependence on it.

These estimates have been widely quoted and at the time of publication they were the most comprehensive statement of uranium resources available. Nearly 1 1/2 years have since passed and exploration activity has increased to the highest level for uranium in history. Has the situation changed significantly?

A new report just received from the European Nuclear Energy Agency provides a ready comparison. It shows a reserve total of 700,000 tons U_3O_8. This decrease results from the exclusion of United States by-product potential which will only become available at a relatively slow rate.

Thus there have not been any changes since 1967 to significantly change the ENEA ore reserves tonnages estimates in the "reasonably assured" category. In North America, where much activity is concentrated, changes have been minimal. e.g. The U.S. Atomic Energy Commission reported a net increase in U.S. reserves of only 7,000 tons in 1968. It is of course quite possible that some

additions to reserves have not been reported; for example, extensions to present orebodies. There are no confirmed reports of tonnage estimates in new areas, although discovery holes of undetermined potential have been reported. This is to be expected since in any area there will be a time lag between favorable holes and determination of the existence of a commercial deposit by additional drilling. We must wait for more information before any objective assessment of possible new reserves can be made.

Indeed, the most striking point that emerges from any review is the lack of change in reserves despite the massive exploration effort that has been launched. The reserve figure will move up of course, but certainly there is not sufficient reported information for proposing a change in the reserve tonnages as now compiled.

Present world resources, coupled with the existing production capability of the mining industry, provide a sound base from which to develop greater capabilities. This is a good starting position. But maximum effort will be needed to maintain a favorable position in the face of the rapidly rising consumption curve. By 1980 world uranium cumulative requirements will have reached 500,000 tons, half of it in the United States. This is far more than all the uranium oxide (380,000 tons) produced before 1968. Predictions beyond 1980 become very difficult and speculative, but U.S. Atomic Energy Commission studies suggest that cumulative U.S. domestic requirements alone could be in the order of 1,000,000 tons U308 by the year 2,000. A British official has estimated that World cumulative requirements will then be 3,000,000 tons U308. To bring this into perspective please recall that the world production rate at its maximum was 40,000 tons per year.

The Chase Manhattan Bank* has just completed a thorough review on the outlook for uranium, because long-range trends in energy are so vital to the economy. In summary,- they estimate assured world ore reserves under $10. per pound U308 at 645,000 tons, - about 10% lower than the most recent ENEA report. Total world demand to 1980 for loading and burn-up in reactors is estimated at 430,000 tons. They emphasize that additionally a 10 year forward reserve is needed. Their study indicates that the nuclear mining industry will have to provide,- as a minimum,- 1.1 million tons of U308 by 1980 to meet worldwide consumption and reserve requirements.

TABLE 2 U308 REQUIREMENTS TO 1980 (In Short Tons)

	United States	Other Countries	Total
Cumulative Consumption	264,000	166,000	430,000
+ 10 year reserve	397,000	274,000	671,000
TOTAL REQUIREMENT	661,000	440,000	1,101,000

*U308 - The Outlook for Uranium - by the Energy Division, Chase Manhattan Bank N.A. March, 1969

Other agencies have assumed an 8 year reserve/consumption ratio. Chase Manhattan economists point out ---- and I quote "Assured resources seem to exist to meet anticipated demand through 1980 by a wide margin although to keep the price below $10. per pound, at least an additional 424,000 tons of low cost reserves must be proved up during the 1968/1980 period".

One must not, of course, equate resources with demand without consideration of production rates. Canada and the United States fortunately have well established mines and mills. These together with those of other world producers have a present annual output of about 23,500 tons U308. To meet consumer requirements the annual production rate must increase to 40,000 tons per year by 1975, and must double again, to about 80,000 tons annually by 1980. As we look ahead to the rapid increase in market demand we must not forget that we are still on the low end of the curve; - we still have a production capability exceeding consumption. But this is a situation that will soon change. It is perhaps a classic opportunity for consumers to adopt long-term measures to ensure future deliveries. Some reluctant consumers have opted for short-term procurement policies; other have recognized the value and the need for long-term contracts for an orderly market.

But there are still some purchasers who do not recognize that production planning by mining companies will tend to be short range if most supply contracts are short-term. Short-term planning for mines soon results in higher production costs and inability to respond quickly and economically to market demands. The result is that, in a growing uranium market, short-term purchasing policies initally may find some"bargains" in small lots. But the delayed effect is to increase the cost to the purchaser. The producer, uncertain about production schedules, is forced to adopt higher cost, short range production and development policies. Better dialogue will help to correct this situation; and I am happy to say that we now find more willingness by the utility companies to frankly discuss mutually advantageous policies for the long-term benefit of Buyer and Seller.

In brief, then, we begin the new nuclear era with a good reserve position. Requirements of the next decade are so high that this advantageous starting position must be reinforced by a maximum effort to find additional reserves for the late seventies. Certainly, major expansion of production capabilities will be dependent on development of new ore reserves.

OUTLOOK FOR ADVANCES IN URANIUM PROCESSING METHODS

Hydrometallurgical extraction methods have been successful for uranium recovery and there is no reason to believe that the next few years, - or even the next decade, - will see any radically new approach. In fact hydrometallurigical processes will become more common in the recovery of other metals. New uranium mills now in the planning stage will be similar to existing mills, with some refinements. The outlook for the next decade is for the continued use of proven processes, but with a wider use of process control measures such as advanced instrumentation and possibly process computers. There is considerable interest in ore preparation methods to separate and discard barren and low-grade fractions of the mined ore to obtain a higher grade feed for the mill. Some progress in this approach can be expected.

CURRENT EXPLORATION

Nearly every major mining company in the United States and Canada has a uranium exploration program, and many large American oil companies have entered into the competition for uranium reserves. The result is that, in comparison with the original boom of the 1950's

---- more money is being spent in the search

---- drilling is at a higher rate

---- many more skilled people are involved

Among the most active are companies which are experienced in the uranium industry, in production and exploration; other companies with the capabilities and financial resources to competently undertake large-scale mineral search programs are in the field too. These include major mining and oil companies with massive capital who are recent entrants in the uranium field, and accustomed to risk ventures. The international importance and scope of the search is demonstrated by developments in 1968 when the interest of foreign companies resulted in joint ventures with North American partners. Principal companies from Japan and Europe now are participants in joint ventures in the United States and Canada. It is to be expected that this trend will continue and the geographical areas for such ventures will broaden. Foreign participants, some without exploration or mining experience, are willing to accept a new type of business risk as a positive measure to help ensure a nuclear fuel supply for their reactors. Another distinctive feature is that Canadian mining firms have large and very active exploration programs in the United States, and well-financed American companies are prominent in exploration in Canada. North America, because of its past record and its potential, is the principal area for exploration; however exploration by North American groups already has extended to South America, Australia and Africa.

AREAS OF PRINCIPAL INTEREST

As an indication of the extent and trend of effort to find new reserves in new areas as compared with extensions of established areas we can observe U.S. drilling reports.

---- In 1967 10.8 million feet of surface drilling was divided evenly between exploration and development drilling along known trends in productive districts.

---- In 1968 24 million feet of surface drilling probably will be 65% exploration, 35% development.

We can expect that drilling will continue for several years at the 1968 annual rate, with an increased proportion for exploration drilling as new areas graduate from the preliminary examination stages.

There are significant differences in the conditions for exploration as compared with the 1950's. The very intensive work of that decade resulted in the discovery of a number of areas or districts in North America containing the deposits which form the basis of the uranium industry. And once again there is a great deal of effort to discover new deposits in these "old" or known districts. But in these areas there are few new surface showings to develop; new deposits will be deeper, harder to find and will require more drilling. New deposits in these districts are likely to require underground operations.

In addition to the re-appraisal of known districts, completely new districts now are being investigated in many countries, including Canada. Some locations are geographically remote and are expensive to explore and exploit. Recent discoveries in Africa may be important; new occurrences are reported from South America and Australia; and in Canada a great deal of activity is centered in new areas in Saskatchewan, Quebec and the North West Territories. Uranium is very widely distributed and there are many areas in the world with favorable geological environment which have yet to come under the close scrutiny of the geologist.

At this point I would like to comment on the effects of possible major discoveries of uranium. All segments of the nuclear industry, utility consultants, banks and investment houses agree that new deposits must be found; but some have expressed the view that discoveries of large deposits will depress the selling price of uranium oxide. I must disagree with this view. The market price must be based on the costs of producing uranium plus a profitable return on investment. In the cost of production I include the cost of finding and developing the orebodies and amortizing plant facilities. Large, high grade orebodies, if not geographically remote, certainly will be more profitable than the average mine. Such deposits are rare indeed, and if discovered will not be numerous enough to "take-over" the huge market of the 1970's and 1980's. Average grade deposits and low grade deposits will be needed too, and the price for the uranium they produce must be an attractive incentive to their finding and exploitation. The economics of average deposits in the growing market of the 1970's will have far more effect on the selling price of uranium than will occasional "super-deposits" that may be discovered. I do agree, however, that several such super-deposits would reduce the "scarcity premium effect" on the future selling price of uranium, - and delay the need to mine high cost reserves, - for example those reserves which would require a selling price of $10. - $15. (in 1969 dollars) per pound of U_3O_8. More uranium deposits, - and good ones - will be needed. Their effect will be to increase the supply of reasonably priced uranium; - certainly the effect will not be to reduce the available supply by driving out less profitable producers. This could happen in a contracting or static market but not in the market we envisage for the future.

PROSPECTING TRENDS

In his search the geologist now has available to him improved equipment. Examples are the airborne gamma ray spectrometer, and sensitive radiation detection equipment for ground use. Certain geochemical techniques show possible value in exploration, as do methods for the detection of radon gas in soils and water. Techniques, of course, can only be supplementary to geological principles, and act as aids to the geologist's judgment. Better map coverage and more extensive photographic coverage, including "radar type" methods greatly assist structural interpretations. In the future infra-red photography may be valuable for rapid preparation of preliminary geological maps. These are useful tools in the search for uranium; but they can be effective only if used in areas favorable for the occurrence of economic deposits of uranium. The understanding of geologic controls remains of fundamental importance and geologic research to deepen our knowledge of the mechanics of ore deposition continues. As information accumulates and regional reconnaissance mapping continues in unexplored and lesser known areas, new deposits will be found. We can expect that some will be similar to those now being mined; and some will be new types. Remote geographical locations are not the obstacles they once were, but the grade of remote deposits must be high enough to offset geographical disadvantages and they must compete with low-grade deposits near established centres. In the vicinity of deposits now being exploited exploration work will continue for many years, - much of it at increasing depths. In summary, I am confident that intelligent effort, using the best techniques available and supported by the resources of experienced companies, is the best possible assurance that the uranium requirements of the late 1970's and beyond will be met successfully.

OUTLOOK FOR THORIUM

I will restrict my comments on thorium to a brief summary of reserves and Canada's position because there are really no significant developments to report.

The present uses of thorium are chiefly in magnesium alloys and gas lamp mantles. It is well known that thorium has a potential as a nuclear fuel for advanced converter and breeder type reactors, but a commerical market is not likely to develop before the 1980's. Reasonably assured thorium resources are in the order of half a million tons, at prices under U.S. $10. per pound ThO_2. There is at present no incentive to develop these resources because of world over-supply. In Canada, thorium is recoverable as a by-product of uranium operations in the Elliot Lake area where the concentration in the ores is in the order of 3/4 to 1 pound per ton. Canadian thorium resources are estimated at 200,000 tons, - a very substantial proportion of the known resources of this metal. Resources are more than adequate for any probable requirement.

U.S. RESTRAINTS ON CANADIAN URANIUM

I think it is appropriate at this time to comment on an inequality in the international trade between friendly nations with nuclear electric power programs. Canadians have been reluctant to express their views to United States authorities on American trade restrictions on foreign uranium, because an early change in U.S. policy was expected. Perhaps we have been too reluctant.

In all projections one central fact stands out clearly; the U.S. market over the next decade will require one-half of all uranium produced in the world, - and very possibly more than one-half. United States industry is the leading supplier of nuclear plant equipment and technology to other countries, and is free to sell uranium in foreign markets. But foreign producers do not have reciprocal rights; - domestic uranium only can be used in the United States. This restriction on Canadian and other foreign imports will apply until mid-1973, unless Congressional action permits earlier easement or lifting of the restrictions.

Although the United States position on uranium imports must be considered a restrictive trade practice there have not been strong objections by other countries. This is mainly due to two factors; - Canada and South Africa are the only two countries, other than the United States, with any really substantial uranium reserves; and there was reason to believe that the restriction would be lifted before 1973. In 1967 and later, statements by American officials made it clear that the matter was under review. This was hopeful but nothing has resulted. And in fact, the mid-1973 date is subject to Congressional review before becoming official. This is a one-way situation indeed, for an international nuclear industry in which the U.S. is the leading exporting nation.

When the import restriction was imposed it was intended as a measure to help domestic mines survive the period of market stagnation, and to encourage exploration for new reserves within the United States. These aims have been achieved. In fact, favorable geological conditions have attracted so many American and foreign companies that the United States now ranks as the most actively explored area in the world for uranium. And U.S. producers no longer need market protection to survive. In my view, the time is past due for the removal of this artificial market restraint so that U.S. consumers will have the advantage of choice in the international market; and the removal of the trade restriction now would contribute to the orderly development of a stable international market. The United States will need Canadian uranium. The fact that American mining and oil companies are so active in uranium exploration in Canada is recognition of that need.

Gentlemen, my purpose has been to outline the outlook for uranium resources and to comment briefly on the measures needed to meet market objectives. I have omitted detail and tables but I hope I have conveyed optimism about our industry's capability to provide the needed resources. There can be problems of timing, - for example, delay in the opening of a true international market for nuclear fuel - and delay in the price incentives for increasing production capabilities. We are in a period of rapid change, - and of great challenges. The next decade will be a fascinating period and the mining industry in welcoming its challenges will be a contender for its rewards.

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April 21, 1969.